

# Case Report of Flipper Anatomic Anomaly of *Sotalia guianensis* From Sepetiba Bay, Rio de Janeiro

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## ABSTRACT

The cetacean flipper consists of a soft tissue that encases most of the forelimb containing humerus, radius, ulna, carpals, metacarpals, and phalanges. Several studies have documented the typical cetacean's flipper anatomy, but only a few described digital anomalies and the most common are fusions and supernumerary such as polydactily and polyphalangy. The flippers of the Guiana dolphin, *Sotalia guianensis* have a falciform general aspect showing individual differences and marks produced by individual contact in social interactions that mainly occur on the posterior border. Here, we report for the first time a case of flippers with anatomical anomalies of loss of digits and deviation of radius of an adult *S. guianensis* from Baía de Sepetiba (22°54'–23°04', 43°36'–44°02'W), Rio de Janeiro, Southeastern Brazil. Anat Rec, 296:1016–1018, 2013. © 2013 Wiley Periodicals, Inc.

**Key words:** anatomy; Cetacea; dolphin flipper; congenital defect

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The cetacean flipper consists of forearm and manus and is generally very conservative with five digits in odontocetes and mysticetes, except in rorquals (Balaenopteridae)

and gray whales (Eschrichtiidae) that have four digits (Watson et al., 1994, 2008). The increase in the number of phalanges (hyperphalangy) is widespread in that order

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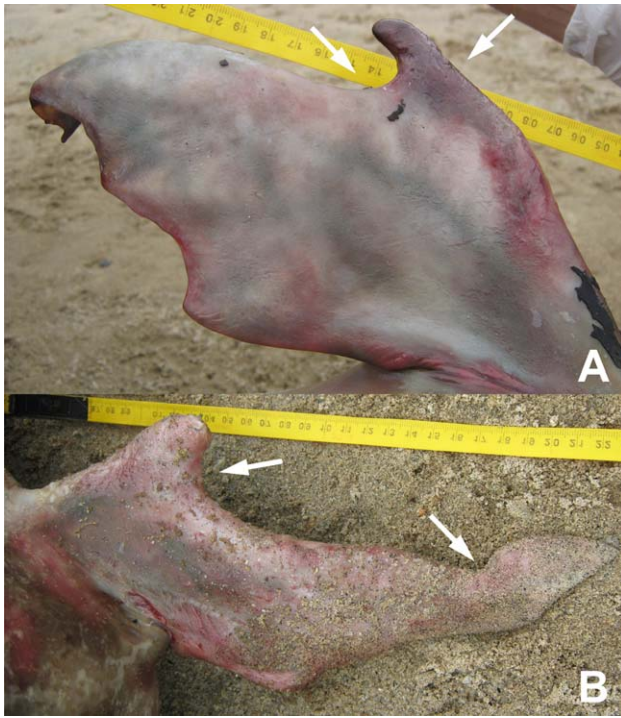


Fig. 1. Macroscopic photos of the anomalous flippers of the dolphin, (A) left and (B) right. Note marked alteration on the anterior border contour with projections that modify the normal convex border, particularly on the right flipper (arrows).

with the exception of digit V (Howell, 1930; Felts, 1966; Cooper et al., 2007; Reindenberg, 2007). The carpal bones are spongy and quite stable ranging between five and six bones and the radius, ulna, and the distal portion of the humerus are flattened and very shortened in odontocetes (Felts, 1966).

Several studies have documented the typical cetacean's flipper anatomy, but only a few described anomalies on digits, carpals, or the forearm. The most common are fusions and supernumerary such as polydactily and polyphalangy (e.g., Watson et al., 2008; Ortega-Ortiz et al., 2000; Cooper and Dawson, 2009).

The flippers of the Guiana dolphin, *Sotalia guianensis*, have a falciform general aspect showing individual differences and marks produced by social contact that mainly occur on the posterior border (Menezes and Simões-Lopes, 1996). Here we report for the first time, a case of flippers with anatomical anomalies of loss of digits and deviation of radius of *S. guianensis* from Baía de Sepetiba (22°54'–23°04', 43°36'–44°02'W), Rio de Janeiro, Southeastern Brazil.

## MATERIAL AND METHODS

Since 1992, the Laboratório de Mamíferos Aquáticos e Biodindicadores of Universidade do Estado do Rio de Janeiro (MAQUA-UERJ) conducts a long-term monitoring of stranded cetaceans along the coast of Rio de Janeiro State, Brazil. In 2010, an adult female of *S. guianensis* (MQ324, total body length 181 cm) was found dead at Sepetiba Bay, Rio de Janeiro, which had

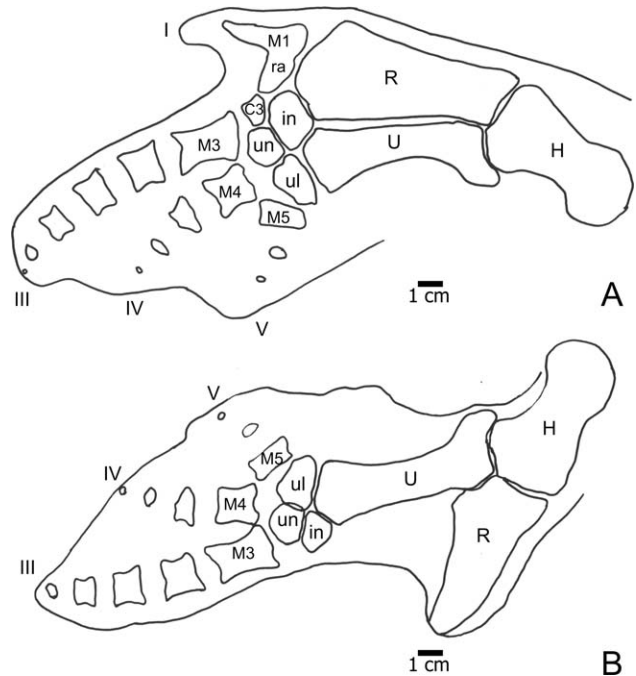


Fig. 2. Representation of the flippers dorsal radiography, (A) Left flipper, humerus (H), radius (R) and ulna (U) with normal conformation. Radiale (ra) fused to metacarpal 1 (M1) generating atypical projection of the anterior border. The metacarpal 2 and the digit II were absent and the carpal 3 is sharply reduced. (B): Right flipper, note the anomalous orientation of the radius (R), ulnare (ul), intermedium (in), and unciform (un) carpals present but radiale (ra), carpal 3 (C3), and metacarpal 1 (M1) absent. Also absent: metacarpals and digits I and II.

macroscopically abnormal pectoral flippers. The biometry and necropsy was performed and no other anomalies were observed in any other structure or organ. The skull and flippers were removed. The abnormal flippers were subjected to dorso ventral radiographic scanning.

## RESULTS AND DISCUSSION

Both anomalous flippers of the dolphin show marked alteration on the anterior border contour with projections that modify the normal convex border, particularly on the right flipper (Fig. 1, arrows).

When compared to the literature (see Menezes and Simões-Lopes, 1996; Simões-Lopes and Menezes, 2008), the most important bone alterations are observed in the right flipper. These anomalies correspond mainly to the strange orientation of the radius (R) that is pointing out instead of making contact with the carpals (Figs. 1 and 2). The ulnare (*cuneiforme*, *ulnare*, ul), intermedium (*lunatum*, in), and unciform (un) carpals were present at the distal portion of the ulna (U) but the radiale (*radiale*, *scaphoideum*, ra) as well as the carpal 3 (*magnum*, *capitatum*, C3) and metacarpal 1 (M1) were absent. Metacarpals and digits I and II were also completely absent in the right flipper.

The left flipper showed minor changes (Figs. 1 and 2). The humerus (H), radius, and ulna showed normal conformation. The radiale was fused to metacarpal 1 and this set generates one atypical projection on the

anterior border of the flipper. The metacarpal 2 and the digit II were totally absent and the carpal 3 is sharply reduced.

In general, digital anomalies are poorly detected and studied because the interdigital membrane in the cetacean flipper masks underlying skeletal anomalies (Cooper and Dawson, 2009). Flipper pathologies can result from developmental or acquired circumstances. The loss or duplication of bone elements may be caused by alterations in genes or developmental pathways in the presence of a teratogen, for instance. Whereas acquired conditions can show different features and are result of traumas, degenerative, or metabolic disease (Cooper and Dawson, 2009). There are studies on genes involved in the flipper development and the hypothesis to the evolution toward hyperphalangy, polyphalangy, and cases of polydactily (Bejder and Hall, 2002; Richardson and Oelschläger, 2002; Cooper et al., 2007; Cooper and Dawson, 2009), but no reports of infranumerary digits or phalanges.

We assume that this is a congenital defect, a case of flipper malformation causing the loss of digits, carpals, metacarpals, and abnormal position of the radius, considering that these are normally developed at embryo stage. To the authors' knowledge there is no other record of loss of elements such as in this case and this is the first where the gross flipper morphology correlates with underlying digital anomalies.

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#### LITERATURE CITED

- Bejder L, Hall BK. 2002. Limbs in whales and limblessness in other vertebrates: mechanisms of evolutionary and developmental transformation and loss. *Evol Dev* 4:445–458.
- Cooper LN, Berta A, Dawson SD, Reidenberg JS. 2007. Evolution of hyperphalangy and digit reduction in the cetacean manus. *Anat Rec* 290:654–672.
- Cooper LN, Dawson SD. 2009. The trouble with flippers: a report on the prevalence of digital anomalies in Cetacea. *Zool J Linn Soc* 155:722–735.
- Felts WJL. 1966. Some functional and structural characteristics of cetacean flippers flukes. In Norris KS, editor. *Whales, dolphins and porpoises*. Berkeley: University of California Press. p 255–276.
- Howell AB. 1930. *Aquatic mammals: their adaptations to life in the water*. Springfield: Charles C. Thomas. 338 p.
- Menezes ME, Simões-Lopes PC. 1996. Osteologia e Morfologia da aleta peitoral da forma marinha de *Sotalia fluviatilis* (Cetacea-Delphinidae) no litoral do sul do Brasil. *Estudos de Biologia, Curitiba* 4:23–31.
- Ortega-Ortiz JG, Villa-Ramirez B, Gersenowies JR. 2000. Polydactily and other features of the manus of the vaquita, *Phocoena sinus*. *Mar Mamm Sci* 16:277–286.
- Reidenberg JS. 2007. Anatomical adaptations of aquatic mammals. *Anat Rec* 290:507–513.
- Richardson MK, Oelschläger HA. 2002. Time, pattern, and heterochrony: a study of hyperphalangy in the dolphin embryo flipper. *Evol Dev* 4:435–444.
- Simões-Lopes PC, Menezes ME. 2008. Capítulo 3: morfologia esquelética. In Monteiro-Filho ELA, Monteiro KDKA, editors. *Biologia, ecologia e conservação do boto-cinza*. São Paulo: Páginas e Letras Editora e Gráfica. p 17–38.
- Watson AG, Stein LE, Marshall C, Henry GA. 1994. Polydactily in bottlenose dolphin *Tursiops truncatus*. *Mar Mamm Sci* 10:93–100.
- Watson A, Kuo TF, Yang WC, Yao CJ, Chou LS. 2008. Distinctive osteology of distal flipper bones of tropical bottlenose whales, *Indopacetus pacificus*, from Taiwan: mother and calf, calf with polydactily. *Mar Mamm Sci* 24:398–410.